
Musella lasiocarpa var. *rubribracteata* (Musaceae), a New Variety from Sichuan, China

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ABSTRACT. Taxonomic study of the diversity of *Musella lasiocarpa* (Franch.) C. Y. Wu ex H. W. Li (Musaceae) in China has revealed an attractive new variety from Sichuan Province, southwestern China. *Musella lasiocarpa* var. *rubribracteata* Zhenghong Li & H. Ma differs from the autonymic variety by its orange-red to red bracts, the reddish to purple-red coloration of the abaxial surfaces of the petiole and leaf midrib, and a weaker ability of clone reproduction.

Key words: China, IUCN Red List, Musaceae, *Musella*, Sichuan.

Musella lasiocarpa (Franch.) C. Y. Wu ex H. W. Li represents the monotypic genus *Musella* (Franch.) C. Y. Wu & H. W. Li in the family Musaceae (Li, 1978, 1979; Wu & Kress, 2000). The taxon is endemic to southwestern China, found primarily in central and northwestern Yunnan and southern Sichuan provinces. Morphologically, this taxon is the most easily recognizable one within the Musaceae, distinguished from *Musa* L. and *Ensete* Horan. by its dwarf, congested pseudostems less than 60 cm long, erect compact rosette inflorescences with yellow to yellow-orange bracts, and short, hirsute fruits not exceeding 5 cm. This attractive plant has been horticulturally introduced into various regions and botanical gardens around the world (Liu et al., 2002).

Musella lasiocarpa possesses a complex taxonomic history. It was first placed in *Musa*, then in *Ensete*, and then back in *Musa* before its monotypic status was eventually recognized (Cheesman, 1947; Simmonds, 1960; Li, 1978). Molecular systematics based on ITS and *trnL-F* sequence data supports the status of *Musella* as a monotypic genus (Liu, 2001). In addition, embryological features further prove that *Musella* should be a distinct genus (Xue et al., 2007).

Wild populations of *Musella lasiocarpa* have been known to exist on cliffs within the watershed of the upper Yangtze River and its tributaries, in northern Yunnan and southern Sichuan provinces in China. It is now difficult to find wild populations because

appropriate habitats have been fragmented due to widespread cultivation. However, *M. lasiocarpa* is locally common in this region of southwestern China and is maintained as a semi-cultivated plant. This taxon is extensively used by farmers as fodder for livestock, for erosion control, and as weaving material. Plants have been utilized as an edible vegetable, as medicine, in wine making, and even as a resource for honey production (Liu et al., 2003; Long et al., 2008).

Considering the high ornamental value and endemism of *Musella lasiocarpa*, we have been committed to investigate the diversity of wild populations since 2004. To date we have documented eight wild populations and compared their genetic diversity with that of cultivated populations (Pan et al., 2007). As a corollary to our continued fieldwork, attractive plants of *Musella* with orange-red to red bracts, rather than the expected paler coloration of yellow to yellow-orange, were found in a single wild population in Panzhihua City, Sichuan Province. In association with other distinctive morphological characters, we conclude that these plants represent a new variety of *M. lasiocarpa*, which is described below.

1. *Musella lasiocarpa* (Franch.) C. Y. Wu ex H. W. Li, Acta Phytotax. Sin. 16(3): 56–57. 1978. Basionym: *Musa lasiocarpa* Franch., J. Bot. (Morot) 3(20): 330–331, fig. 1. 1889. *Ensete lasiocarpum* (Franch.) Cheesman, Kew Bull. 2(2): 102. 1947. TYPE: Fig. 1 in Franchet, 1889 (lectotype, designated by Häkkinen & Väre, 2008: 81).

1a. *Musella lasiocarpa* var. *lasiocarpa*.

Musella lasiocarpa var. *lasiocarpa* can be distinguished by its floral bracts that are yellowish green to yellow. These bracts can sometimes be orange near the margins. The petioles are light green or green, but seldom with a reddish tinge; the leaf blades are similarly green without red coloration. Plants of

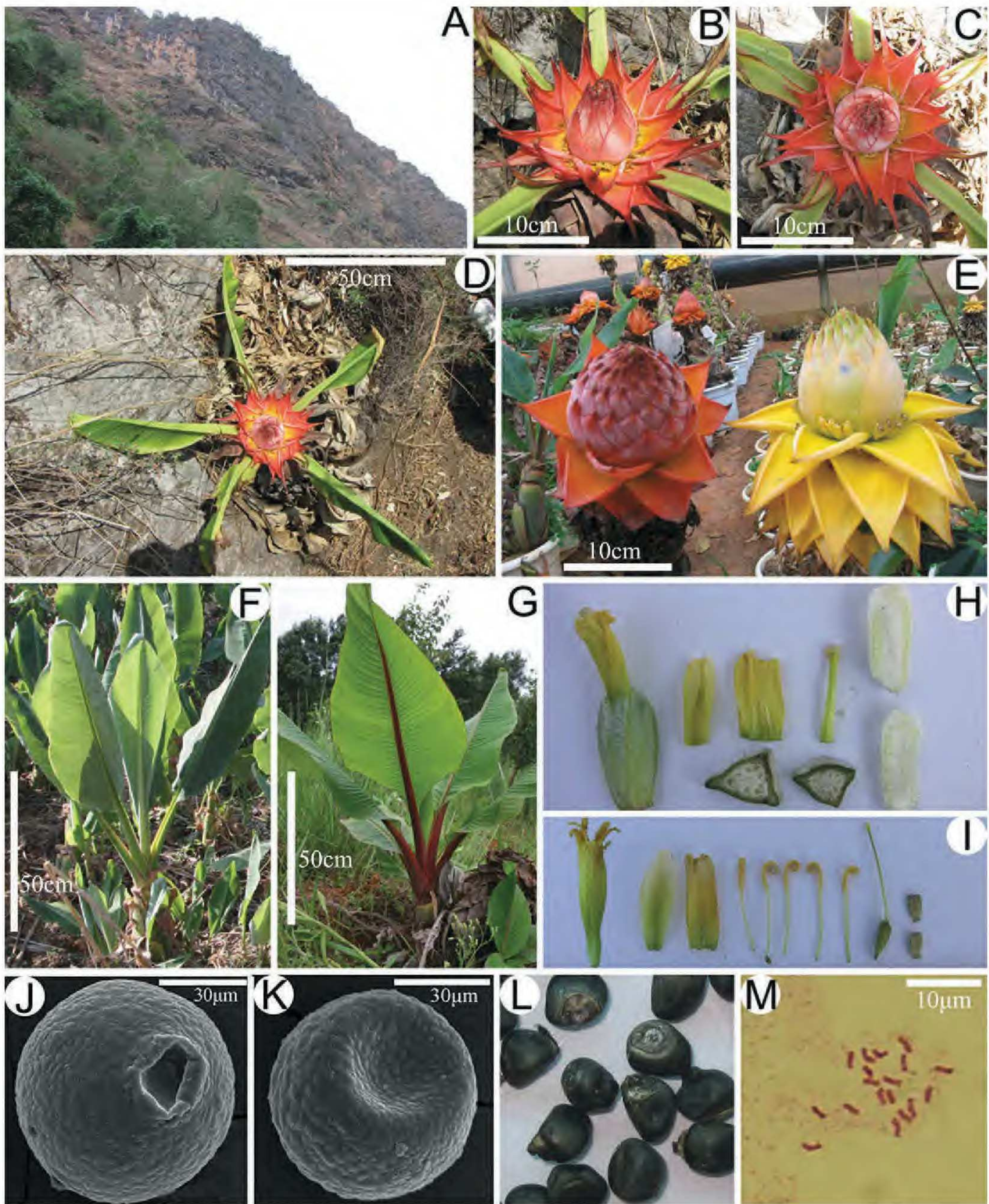


Figure 1. *Musella lasiocarpa* var. *rubribracteata* Zhenghong Li & H. Ma. —A. Habitat. —B, C. Inflorescences in the wild. —D. Plant with inflorescence in the wild. —E. *M. lasiocarpa* var. *lasiocarpa* (right) and *M. lasiocarpa* var. *rubribracteata* (left) cultivated in the greenhouse. —F, G. Leaves of *M. lasiocarpa* var. *lasiocarpa* (F) and *M. lasiocarpa* var. *rubribracteata* (G) showing differences of color of leaf margin, midrib, and petiole. —H. Pistillate flower, showing its components and cross sections of ovaries. —I. Staminate flower, showing its components. —J, K. Scanning electron micrograph showing pollen morphology of single aperture (J) and leptoma (K) in distal pole view. —L. Seeds. —M. Somatic metaphase chromosomes ($2n = 18$). Photo by H. Ma and Q. J. Pan.

variety *lasiocarpa* readily tiller, with more than five tillers observed per individual, rarely three or four; clonal plants could be obtained easily from tillers and unopened young flowers by tissue culture. Fruits number (11 to)19 to 32(to 41) per inflorescence (Ma & Li, pers. obs., from Yunnan and Sichuan provinces, respectively).

Specimens examined. CHINA. **Yunnan:** Near Km marker 71.5 W of Kunming City on Burma Rd., cultivated on dike at edge of paddy fields, ca. 1900 m, 25 July 1984 (fl.), *Sino-American Botanical Expedition to Yunnan Province, China 1311* (KUN 0233084).

1b. *Musella lasiocarpa* var. *rubribracteata* Zhenghong Li & H. Ma, var. nov. TYPE: China. Sichuan: Panzhihua City, near Upper Yangtze River, 27°05'N, 101°38'E, 1120–1230 m, 15 May 2009 (fr.), *Z. H. Li & H. Ma 09SC66* (holotype, IFRD). Figures 1, 2.

Haec varietas a *Musella lasiocarpa* (Franch.) C. Y. Wu ex H. W. Li var. *lasiocarpa* bracteis aurantiaco-rubris usque rubris, foliorum petiolis abaxialiter et costis utrinque rubellis usque coccineis atque reproductione clonali debiliore differt.

Herbs perennial, tufted; rhizomes horizontal, occasionally sprouting 1 to 4 axillary and basal tillers; pseudostems reddish green, with persistent leaf sheaths, 23–45 × 11–28 cm. Canopy leaves 121–234 cm diam.; leaves expanded proximally into a sheath; blades glabrous, narrowly elliptic, bilaterally symmetric, base subrounded or cuneate, margin entire, reddish green, apex acute or long acuminate, sometimes with spirally thin and long caudate extension, 30–115(–150) × 5–30(–40) cm, abaxial surface often waxy or glaucous, pale green, midrib distinct, light red to purple-red, adaxial surface green to dark green, veins pinnate, distinct along midrib; petiole glaucous, abaxially reddish green to purple-red, 9–47 cm, channeled, margin somewhat membranous, reddish green. Inflorescences indeterminate, terminal, sometimes axillary near base of pseudostem, erect, conical to subglobose, dense, (12–)18–25(–30) cm; bracts (3)5 per whorl, with pistillate flower (with reduced stamens) bracts (3)4 to 7(to 11) in whorls at base and subsequently with staminate flower (with reduced gynoecium) bracts more than 6 whorls above, ovate, zygomorphic, base arciform, margin entire, apex acuminate to caudate, sometimes curving, scarious, persistent, 8.5–18 × 6–10 cm, abaxial surface glaucous, orange-red to red, adaxial surface orange-red to red, sometimes orange near base; flowers arranged in lines with each cluster of flowers subtended by a single bract on an inflorescence; pistillate flowers 3 (occasionally 2 or 4, rarely 1) per bract, tepals 2, usually tubiform, full

of nectar, 1.1–1.5 × 0.4–0.8 cm; compound tepals ovate, rectangular to rectangular-orbicular, bilaterally symmetric, margin entire, 5-toothed at apex, 1.5–2.8 × 1.2–2.2 cm, yellowish to yellow, lower part greenish; free tepals ovate-oblong, bilaterally symmetric, membranous, semi-transparent, margin entire, rugulose or wrinkled near apex, emarginated and sometimes shortly cuspidate at apex, 1.4–2.8 × 1.2–2.6 cm, yellowish to yellow, lower part greenish; ovary inferior, broadly ellipsoid or trigonous-ellipsoid, densely hirsute or villous-pilose (with whitish to hyaline trichomes), greenish, 1.9–3.8 × 0.5–2.3 cm diam., locules 3, placentation axile, with 2 lines of ovules; style 1, cylinder trigonous, greenish yellow, 2.1–2.5 × 0.2–0.3 cm; stigma compressed-globose to subglobose, surface concavo-convex, whitish; reduced stamens 5, acuminate, yellow, greenish in lower portion, anther absent, ca. 1.4 × 0.2 cm diam.; staminate flowers (3)4 to 6 per bract, tepals 2, tubiform, full of nectar, 2.1–4.2 × 0.3–0.9 cm, compound tepals 2.3–4.5 × 1–2.2 cm; free tepals 2.3–4.5 × 1.2–2.8 cm; androecium with 5 stamens; filaments subequal, 0.8–2.4 cm; anthers 2-locular, subrectangular, usually reflexed, connective apex emarginate, 1.4–2 × 0.1–0.3 cm, yellow to orange-yellow; reduced gynoecium consisting of the ovary inferior, obovoid, glabrous or sparsely pilose, green, 0.9–1.4 × 0.4–0.6 cm, with ovule absent, style 1, filiform, 2.3–4.7 cm, stigma yellow. Fruit as berries, 3 (occasionally 2 or 4, rarely 1) per bract, (2 to)12 to 22(to 27) per inflorescence, trigonous or tetragonous ovoid or subglobose, densely hirsute, yellowish, green in upper portion, 2.7–5.1 × 2.6–4.8 cm; seeds oblate or irregular, glabrous, black-brown to black, 0.5–1.1 cm diam., 100-seed weight ca. 10 g. Pollen spheroidal, actinomorphic, simple tremoid on distal polar, exine sculpture verrucate, dotted with irregularly ridged tips (Fig. 1J, K). Chromosome number: $2n = 18$.

Distribution and habitat. *Musella lasiocarpa* var. *rubribracteata* is known only from the type locale of Panzhihua City, in southern Sichuan Province, China. The number of mature plants was estimated at fewer than 130 individuals and its geographic range as less than 12 km². The variety was observed to grow on limestone cliffs of a dry, hot valley, 1136–1254 m in elevation. The distance between *M. lasiocarpa* var. *rubribracteata* and the nearest population of its autonymic variety *lasiocarpa* is ca. 10 km. *Novelia insignis* Franch. (Asteraceae) also occurred at the type locality, with an estimated population of 80 individuals.

IUCN Red List category. We assess the conservation status of this new variety as Critically

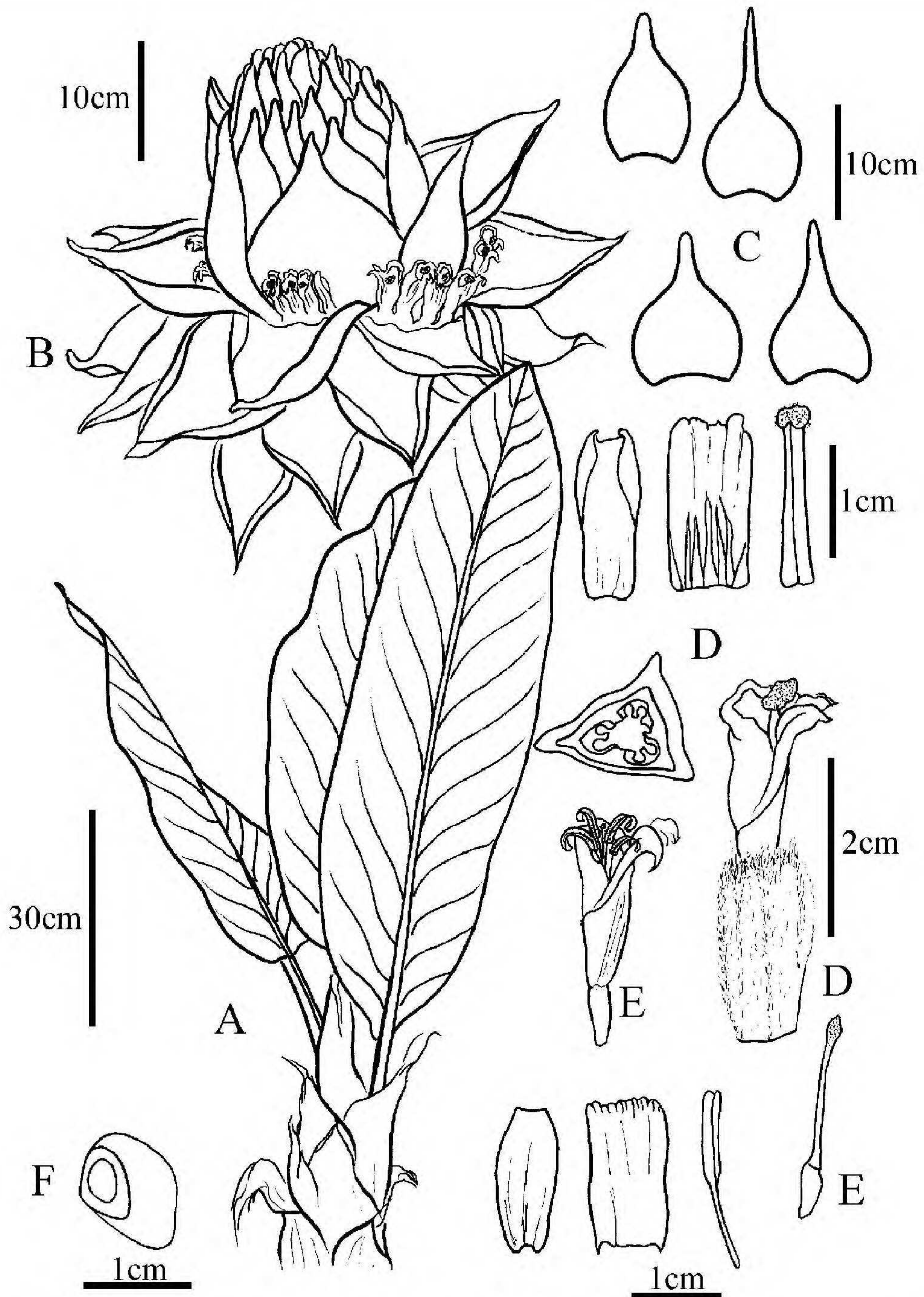


Figure 2. *Musella lasiocarpa* var. *rubribracteata* Zhenghong Li & H. Ma. —A. Plant habit. —B. Inflorescence. —C. Four bracts, showing diversity of shapes. —D. Pistillate flower, showing its component parts and ovary cross section at left. —E. Staminate flower, showing its component parts below. —F. Seed. A–F drawn from the holotype Z. H. Li & H. Ma 09SC66 (IFRD). Drawing by L. Wang.

Endangered or CR B1ac(iv), according to IUCN Red List criteria (IUCN, 2001), because it is known to exist at only one location and the number of mature plants might fluctuate drastically in the future.

Phenology. The new variety was observed in the greenhouse to flower from February to November, and fruiting was observed throughout the year on different plants. The subsequent anthesis of pistillate flowers on a plant occurred over a ca. 20-day interval, with six days observed for a single flower. For staminate flowers, anthesis for an individual plant ranged from 15 days to several months, with an interval of ca. five days for single flowers (Ma & Pan, pers. obs.).

Cytology. The somatic chromosome number was documented as $2n = 18$, which corresponds to what has been reported for *Musella lasiocarpa* var. *lasiocarpa* (Chen et al., 1991). The chromatids ranged from ca. 2.6–4.3 μm long (Fig. 1M). Because the chromosome number does not vary between the two taxa, recognition of the novelty is restricted to the varietal rank rather than species.

Taxonomic relationship. *Musella lasiocarpa* var. *rubribracteata* distinctly differs from the autonymic variety by its orange-red to red bracts that are sometimes orange near the bract bases. A reddish green to purple-red coloration is seen on the abaxial petioles, and the leaf midrib can be light red to purple-red on the abaxial surface and occasionally on the adaxial surface, in contrast to the green lamina. *Musella lasiocarpa* var. *rubribracteata* demonstrates a lesser tendency to clonally reproduce, with only one to four tillers observed per plant. Propagation was difficult from tillers and unopened young flowers by tissue culture resulting from severe browning. Bracts of plants developing from tillers of *M. lasiocarpa* var. *rubribracteata* were also orange-red to red in color. Plants of variety *rubribracteata* tend to produce fewer fruits on average, with (2 to)10 to 22(to 27) per inflorescence.

Paratype. CHINA. **Sichuan:** Panzhihua City, near Upper Yangtze River, 27°05'N, 101°38'E, 1120–1230 m, 1 May 2011 (fl.), Z. H. Li & H. Ma 2011SC009 (KUN).

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Literature Cited

- Cheesman, E. E. 1947. Classification of the bananas. *Kew Bull.* 2: 97–117.
- Chen, S. Z., Z. Y. Chen, X. X. Huang, S. P. Huang, Y. Q. Wang & Z. F. Zhao. 1991. Fifty taxa chromosome counts. *Guihaia* 10: 33–37.
- Franchet, M. A. 1889. Un nouveau type de *Musa lasiocarpa*. *J. Bot.* 3: 329–331.
- Häkkinen, M. & H. Väre. 2008. Typification and check-list of *Musa* L. names (Musaceae), with nomenclatural notes. *Adansonia*, sér. 3, 30: 63–112.
- IUCN. 2001. IUCN Red List Categories and Criteria, Version 3.1. Prepared by the IUCN Species Survival Commission. IUCN, Gland, Switzerland, and Cambridge, United Kingdom.
- Li, X. W. 1978. The Musaceae of Yunnan. *Acta Phytotax. Sin.* 16: 54–64.
- Li, X. W. 1979. Musaceae. Pp. 725–733 in C. Y. Wu (editor), *Flora of Yunnan*, Vol. 2. Science Press, Beijing.
- Liu, A. Z. 2001. Phylogeny and Biogeography of Musaceae. Ph.D. Thesis, Kunming Institute of Botany, Chinese Academy of Sciences, Kunming.
- Liu, A. Z., W. J. Kress & D. Z. Li. 2002. Insect pollination of *Musella lasiocarpa* (Musaceae): A monotypic genus endemic to China. *Pl. Syst. Evol.* 235: 135–146.
- Liu, A. Z., W. J. Kress & C. L. Long. 2003. Customary use and conservational attention to *Musella lasiocarpa* (Musaceae): A monotypic genus endemic to China. *Econ. Bot.* 57: 279–281.
- Long, C. L., S. Ahmed, X. R. Wang, Y. Liu, B. Long, C. Yang, Y. Shi, X. Li & R. Guo. 2008. Why *Musella lasiocarpa* (Musaceae) is used in southwest China to feed pigs. *Econ. Bot.* 62: 182–186.
- Pan, Q. J., Z. H. Li, Y. Wang, J. Tian, Y. Gu & X. X. Liu. 2007. Rapid analysis on the genetic diversity of wild and cultivated populations of *Musella lasiocarpa*. *Forest Res.* 20: 668–672.
- Simmonds, N. W. 1960. Notes on banana taxonomy. *Kew Bull.* 14: 198–212.
- Wu, D. L. & W. J. Kress. 2000. Musaceae. Pp. 314–318 in C. Y. Wu & P. H. Raven (editors), *Flora of China*, Vol. 24. Science Press, Beijing, and Missouri Botanical Garden Press, St. Louis.
- Xue, C. Y., H. Wang & D. Z. Li. 2007. Female gametophyte and seed development in *Musella lasiocarpa* (Musaceae), a monotypic genus endemic to southwestern China. *Canad. J. Bot.* 85: 964–975.